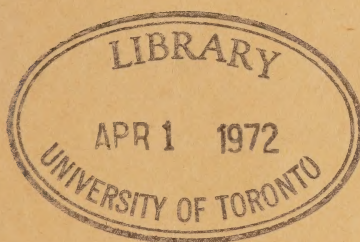


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## ONTARIO RESEARCH FOUNDATION

- 1—Aims of the Ontario Research Foundation. By Sir Joseph Flavelle, Bart., Chairman, Ontario Research Foundation (Reprinted from "Industrial Canada," January, 1930).
- 2—The Ontario Research Foundation—A Progress Report. By H. B. Speakman, D.Sc., Director, Ontario Research Foundation (Lecture delivered before the Royal Canadian Institute, Feb. 8, 1930).
- 3—Industrial Research in Canada in 1930. By H. B. Speakman, D.Sc. (Reprinted from "The Globe," Toronto, Jan. 6, 1930).



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## AIMS OF THE ONTARIO RESEARCH FOUNDATION

THE manufacturers of cotton fabrics in England have, for years, had a hard time to secure a reasonable return upon capital invested. They continue to have unsatisfactory results, and there is anxiety and concern generally throughout the trade. The following letter, under date of September 24th of this year, from one of these manufacturers to Dr. Speakman, the Director of the Ontario Research Foundation, furnishes in short form, an experience which may be of interest to manufacturers throughout the country:

"I am enclosing you a copy of what I said at the Annual Meeting of my Company, but I am very conscious of the fact that it will not be of very great assistance to you as only a few words were devoted to the subject.

"Perhaps there is sufficient to show that we are stronger believers than ever in the application of science, and I think, if I were asked what particular section of our business had been most valuable to us in helping towards our success, I would unhesitatingly say the Research Department.

"We started the work rather differently from many other concerns. We made up our minds that we would endeavour to solve a particular problem which had baffled the cotton industry. I remember

reading an address given by Professor E. H. Starling, in which he says:—

“‘Even a life-time devoted to science and research seems incapable of preventing us from accepting familiar appearances without trying to understand them. It is not until someone puts a definite question and our curiosity is roused that we become aware of a problem to be solved. In science it is the question that matters; the solution can always be found.’

“We took up our question some ten or twelve years ago; the solution has not yet been completely found, but we are on the way; and during the course of our work our scientists have found a good many other things that have proved very useful, and there is no doubt the whole output of our business has been immensely improved through science.

“I would advise you to try to get the smaller manufacturers to put up problems to you. You may perhaps know that when we started the British Cotton Industry Research Association there were, apparently, no problems that required solution. Everything seemed to be known. Now that the institution has been going some nine years, the Director told me the other day that if the staff were doubled he could hardly keep pace with the work.”

The following is the copy of what the writer of this letter said to the shareholders at the Annual Meeting of his Company:

“Notwithstanding the doleful articles which appear in the press and the daily reports of slack trade, I feel that our balance sheet should give our

shareholders proof that we have good reason for confidence. For the last seven years we have been able to pay a ten per cent dividend. This year also, we recommend you to approve of the payment of ten per cent. Not only are we able to pay this dividend, but you will see that we have provided something to be added to reserve. We therefore do not share the misgivings of some of our neighbours.

“We are now spending some £20,000 a year on scientific research and education—double the sum you voted when the policy was inaugurated. We have not thought it necessary to get your consent annually to the expenditure of money on research, being certain you would agree and even urge us to spend more. We have already proved the value of research; not only have we produced, through science, better articles with new properties never before known in the cotton world, but the general standard of production throughout the Company has been raised as a direct result of our research work. If we are to survive the struggle and competition going on in the world, and if our Company is to achieve still greater success in future, we are convinced it will come to us mainly through research.”

Your readers will observe that this Manchester company has, for years, enjoyed sustained favourable returns from its business, while the cotton industry generally suffered from extremely unfavourable returns. These singular advantages developed out of endeavours to solve by scientific research, “problems which had baffled the cotton industry.” In the doing of it, the company’s scientific staff “found a



good many other things that have proved very useful," and "the business has been immensely improved."

This latter is not an uncommon result associated with serious enquiries, whether practical or scientific. The by-products from researches are frequently valuable, sometimes much more valuable than the advantages derived from the direct quest. The story of this Manchester house is but a reminder that opportunity knocks at all our doors. It is sometimes not heard, because we are not expecting opportunity, much less looking for it, or we are busy making a noise about our misfortunes and we do not hear, or are occupied with something else and have no ears to hear.

A few corporations in Canada are each spending annually upon scientific researches an equivalent or larger sum than the Manchester cotton company, and for the same purpose, and with the same results. A few corporations in the United States are each spending upon scientific research millions of dollars annually, and for the same purpose, and with the same results. In both countries, many other manufacturers have scientific departments as a permanent part of their organizations. These are generally concerned in routine work from which material value is secured. In some of the organizations, however, original researches are carried through with highly beneficial results.

It is regrettable that many more manufacturers in Canada have not come into an understanding of the value of scientific departments as part of their



permanent organizations. Yet when an eminent scientist, by profession a searcher after truth, says—"Even a lifetime devoted to science and research seems incapable of preventing us from accepting familiar appearances without trying to understand them"—the manufacturer in Canada may perhaps be pardoned for accepting the "familiar appearance without trying to understand them," or to question constructively concerning them.

The provision of the needed facilities for carrying through scientific researches, and the direction of the work undertaken, involve important money expenditures and resourceful administration. In consequence, the Canadian Manufacturers' Association and its Committees for years urged that the State should provide these facilities and administration for manufacturers who were unable to undertake single-handed the needed expenditures, and were without the necessary experience in administration. Moreover, they hoped that the broader facilities made possible by official action would have an educative influence upon manufacturers generally, and they would come into an understanding of the value of scientific research as a working asset of primary benefit to their business.

The response came in the vision and faith of the Prime Minister of the Province, the Honourable Howard Ferguson. He added to vision, constructive courage, and stimulated private citizens, private corporations, and the Legislature, to join forces in providing these facilities and the needed administration. Hence the Ontario Research Foundation.

We, then, of the Foundation, administrators, Advisory Council, and staff, are not merchants seeking to sell our wares for profit. We are trustees, responsible to the Lieutenant-Governor-in-Council for the proper discharge of duties laid upon us by the Legislature. What are these duties? Briefly, to provide facilities and administration for scientific researches for the benefit of industry, agriculture, animal husbandry, and for the better understanding and use of the undeveloped, or insufficiently developed natural resources of the Province.

The first qualification for this work with which the Foundation is charged, is an inherent understanding that industry and agriculture are built upon not only hard work, the support of capital, the aggressive zeal of the practical man, but that they get life and sustenance from roots buried deep in the things of the spirit.

“The advance of pure science proceeds in majestic indifference to its uses, but upon that advance, commerce and the practical affairs of life must depend ever more and more.” We, of the Foundation, must therefore have this spirit in us as a necessary qualification in gathering together and guiding a body of scientific men for co-operative effort in scientific researches. The measure of our practical worth will be in the quality, not the size, of the organization which is developed. As for anything further in qualification, I will content myself with quoting the observation of a wise King three thousand years ago—“Let not him that girdeth on his harness boast himself as he that putteth it off.”

What plans has the Foundation whereby the manufacturers who are without scientific departments in their own organizations can be served by the Foundation? We will, when requested, serve the need of individual manufacturers, but where the manufacturer has problems involving serious research, because we are a public body, developed expressly for the purpose of being of value to industry in general, we will ask that groups be formed of those making similar products; we will undertake the needed researches on behalf of such groups, and the members will commonly share in the results. Further, we will ask each group to assume the charge of the researches undertaken. The cost to each member will be relatively moderate for service which, with use, will have cumulative value, not only in the direct result of the researches, but in an awakened sense of opportunities previously unconsidered. These primary and secondary results will grow in importance as experience in partnership relations develops between the Foundation and the groups. We know this from experience in working with groups during the year now closing.

We ask departments of the Government, groups in industry, and where possible, others who bring their problems to the Foundation, to bear the cost of the work done, because it is necessary if the Foundation is to meet the demands which will develop with the years. The endowment fund of the Foundation, established by the generous gifts of private citizens, private corporations, and the Legislature, will at the end of five years aggregate approximately

\$3,500,000.00. The annual income from the investment of these funds in trustee securities will provide an invaluable back-log which will give assurance of stability to the Foundation for the future. This income, however, is and will be wholly inadequate to carry on for all and sundry who will desire to use the Foundation.

The common sense of the matter then is that our usefulness will be multiplied many times over if payment for work undertaken for organized responsible bodies, public or private, is assumed by them. The Foundation's part will be to bring to the enquiries from each group the direct service in research of scientifically trained men who have acquaintance, through experience, with problems kindred in character to the one submitted; to support them with the cumulative knowledge and experience of the steadily enlarging body of scientific men who will staff the Foundation; to apply the benefit in consultation and in practical service of the scientific men in our universities; to have available the reports of research organizations in all countries, and when desirable, to consult with them. Your readers will concede that in these plans we provide for a fair division of responsibility in team play. As in all team play, based upon mutual confidence, useful results will follow. These results in industry, it is hoped, will broadly mean improved methods in manufacture, greater volume in output, lessened costs, better products, additional employment at fair wages, with healthier balance sheets and more satisfactory returns upon invested capital.



Reference should be made to the hesitation of many manufacturers, both smaller and larger, to share in groups as proposed by the Foundation. Their hesitation has arisen from two causes—a not unnatural disinclination to meet the cost of work undertaken by an organization as yet unproved, and hesitation to the point of unwillingness to share in counsel with competitors concerning operating conditions in their plants. I will make a simple rejoinder. The post-war British system for scientific researches, under the guidance of the Department of Scientific and Industrial Research, authorized by the Imperial Parliament, carries on in organized groups of British industries. Each industry builds and equips laboratories, and undertakes scientific researches on behalf of its members, and at their cost, with the assistance of subsidies from funds placed for this purpose with the Department of Scientific and Industrial Research by the British Parliament, and distributed at their discretion. It will be observed the principle is the same as is suggested by the Ontario Research Foundation, but with a difference in method.

The Ontario Research Foundation must undertake the duties with which it is entrusted by the Legislature. In their performance, intimate relations should be established with executives and operating managers of industrial companies. A beginning has been made. I believe the first cause for hesitation, money contribution, will pass. As to the second, I am within the mark in saying, that the executives in a steadily increasing body of industries,

have proved that comparison of methods of operation with competitors, carries possibilities of great advantage. The frank counselling together of men in the same lines of business has ceased to be the exception, and will sooner or later become the rule.

The Foundation, through the generous confidence of the Cabinet Ministers, is in the process of being established in working partnership with the departments of the Government of the Province.

At the request of the Minister of Agriculture, and in co-operation with the Ontario Veterinary College, the Foundation has undertaken to carry through both extensive and intensive researches as to the causes and remedies for contagious abortion in cattle. This disease has become a source of great concern and of serious loss to breeders and dairymen. While the work will probably not be completed for some years, we may have the good fortune to suggest some practical remedial measures during the coming twelve months.

In association with the Minister of Mines and his officers, a beginning has been made in researches in the reduction of the iron ores in the Province. In this work, the Foundation will have the sustained assistance of the scientific and practical workers in the steel plants within the Province; also, in association with the Minister of Mines and his officers, researches in the now definitely established deposits of lignite in Northern Ontario are being planned.

The Foundation has had the opportunity of rendering some service continuously during the year to the woollen manufacturers and to the meat packers.

What has been done has been chiefly routine in character, but some original work of real value has been successfully carried through, and we are now asked to increase the service to both these organizations during the year 1930. Officers of the Foundation have counselled operators in individual plants in matters of technique in heat treatment of steel, and have earned appreciative goodwill for immediate benefit secured. The Director, Dr. Speakman, has been the recipient of many enquiries at the offices of the Foundation, and has had a great body of visitors, asking a widely varied series of questions. These have brought the Director of Research and members of the staff in contact with many interesting and some important industrial phenomena.

I desire to express both official and personal obligation to Dr. Speakman, Director of Researches in the Foundation, for work of very high order during the past eighteen months. Necessarily, the chief duties have been to establish an organization, and to determine and build the needed physical accommodation for laboratory work. He has made an important commencement in a staff of scientific men, who will give a good account of themselves as the years pass.

## THE ONTARIO RESEARCH FOUNDATION— A PROGRESS REPORT

WHEN I was asked to address this old and learned Society I was compelled to balance very conflicting reactions. In the first place, on purely personal grounds I would rather have been excused, if for no other reason than that you have asked me, sir, to join a succession of distinguished scientists who by their own efforts are adding to human knowledge. Some few years ago when I addressed you it was in order to report upon and discuss some of the work done in my Department of this University relating to carbohydrate utilization. Now I must stand before you an apostate who has not for the last two years performed even the simple task of lighting a Bunsen burner. Whether you will consider my apologia adequate remains to be seen. On other than purely personal grounds it is right and proper that I should take this opportunity of reporting to the Royal Canadian Institute the progress made in the creation and operation of the Ontario Research Foundation. This Society will, I hope, justly claim a large share of any credit due to those who have brought about its establishment. Indirectly by the personal achievements of your officers in the various fields of scientific research, more directly by the quality and character of many of your meetings, and still more directly by earnest representations to governments and public bodies,



you have pleaded for a recognition of the supreme value and importance of scientific research to the community. I feel, therefore, that I am addressing a sympathetic audience, one from which I need not hide problems and even disappointments, one which will appreciate the significance of even small beginnings.

Not quite two years ago the Prime Minister of this Province took a first step which almost guaranteed success to this new undertaking. I refer to his choice of Sir Joseph Flavelle as Chairman. You are all aware of his long experience and sound judgment in the fields of finance, industry and many branches of public service, but one characteristic above all these I should like to emphasize. I refer to his ability to create among a group of men a spirit of unity in effort, a comradeship in adversity as well as in prosperity. This was shown most actively during the war in his administration of the Imperial Munitions Board, and the effects are still visible. There is no fraternal or secret order in this or any other country amongst whose members there is a greater spirit of loyalty and friendship than there exists among that band of men who served at home during the war. The job was finished and the organization broken up eleven years ago but the spirit of the thing persists.

The second important step, again taken by the Prime Minister, was to bring the Foundation to the attention of business and financial corporations and private citizens to enlist their financial support. Letters were sent out by him in May, 1928, and in

October promises equal to a sum of \$1,000,000 had been received. At the present time this sum has grown to approximately \$1,850,000, and, with the equivalent which we shall receive from the Provincial Treasury, will amount to  $3\frac{1}{2}$  millions at the end of five years. The officers of the Ontario Division of the C.M.A. rendered great service in securing financial support for the Foundation, particularly their Chairman, Mr. Monypenny. During the last session of the Provincial House a Bill was passed amending the original Act and amongst other clauses was one enabling the Government of the Province to pay an amount equal to that subscribed by the public to the Foundation up to  $2\frac{1}{2}$  million dollars. I sat in the House and listened to the interesting and enthusiastic speeches of the Prime Minister and the two leaders of the Opposition in support of the Bill. One further point in connection with the subscriptions received from private individuals and companies, in not one single instance was the money given with a string attached in the form of a hope or expectation of receiving direct benefit from the work done by the Foundation.

In May, 1928, I was asked by the Chairman to assist him in the early stages of the work. My first job was an immediate attempt to bolster up my own limited experience and knowledge of the field by consulting friends and others at home and in other countries. I visited various institutions in the United States in 1928, and this year I spent a most profitable three weeks visiting some of the Association Research Institutes in England. It has been a great

privilege to draw freely on the long experience of men like Dr. Weidlein, Director of the Mellon Institute; Sir Wm. McCormick, Chairman of the Advisory Research Council; and Dr. Jewitt, Director of the Research Laboratories of the American Telephone and Telegraph Company; but, valuable as their help and advice have been, we have had to interpret finally our problem in our own way. In the first place, the Foundation is, at least in some respects, a new departure and precedent fails. Secondly, even scientific men with experience in the same or similar fields do not always agree. One distinguished American scientist rather damped my enthusiasm by saying that no research enterprise receiving government financial support could possibly succeed, and that we should rely on industry. My courage returned when one of my oldest friends, also a scientist, told me that no attempt at coöperation with industry in scientific research could progress beyond the commonplace and somewhat selfish troubles of industrial companies. When this period of cogitation and enquiry was over, some decision had to be made as to what in the main should be the character of this new organization. The Chairman decided that we must lean in the direction of the Guild or Trade Research Associations which have developed in Great Britain since the war, rather than the Mellon Institute at Pittsburgh or a technical department of the government. In other words, an attempt has been made to associate with the laboratories different groups of manufacturers with interests and problems in common. The Mellon Institute is, on the other

hand, essentially a private corporation doing splendid work for individual companies which support the fellowships, and receive the benefits of the investigations. Government departments usually devote their attention to agricultural and other broad national problems which underlie general prosperity and development, and are not concerned with the various problems of organized industry. From the first, therefore, an attempt has been made to develop an intimate working relationship between a group of scientific men and different groups of men engaged in industry. It is in other words, sir, essentially a human problem, and the Foundation must be a living thing and not a building or collection of buildings containing a museum of men and apparatus. Because it is essentially a living thing it exemplifies certain biological laws. One such law states that "ontogeny repeats phylogeny," or in simpler and more intelligible language, "the individual repeats the history of the race." I should have liked to apply this law to the genus Research Foundation, but time will not permit, and also I dare not venture further, because your President and myself in this section of biological dogma are to each other as barbarians and infidels, or in other words, good friends.

May I say a few words about the staff—the first section of our family. The securing of the right men to undertake this type of work is not easy, and to what extent we have been successful I must leave you and others to decide, but two things I will say, we have lived and worked together now for over a year enjoying our work, and we elect to be judged



as a team and not as individuals. This question of staff tempts me to turn aside and voice my opinions, or prejudices, with regard to the training of men, but I will content myself by saying that research capacity in science is a creative faculty just as much as the gifts of the poet and the musician. The latent power can be developed or suppressed but it cannot be created. The prevalent idea that demand creates supply in this field is mischievous and must lead to disappointment. To-day Canada is suffering from the fact that for years men and women with real scientific gifts have been compelled to leave, not in search of wealth, but merely an opportunity to express themselves in the work they loved.

Having secured the nucleus of a staff of scientific men an attempt has been made to secure the interest and co-operation of various groups of manufacturers. You will be interested in knowing what progress has been made along these lines, but before discussing the matter in detail may I impress upon you the advisability of always remembering that we are reviewing a period of only twelve months or so and the work done has been essentially pioneer work. Both the Chairman and myself feel gratified with the evidence we already have of personal interest on the part of manufacturers scattered all over this Province who have given not only their money, but what is far more important, their time and serious study to the work of the Foundation. The creation of such groups involves a consideration of three ideas each of which presents difficulties, but which when taken together constitute a very formidable obstacle.

During the autumn I visited the Royal Winter Fair and witnessed a magnificent display of horse-jumping. I was interested to observe the tremendous applause given to those competitors who succeeded in negotiating what seemed to a layman like myself the most difficult obstacle, namely, three jumps at short intervals. The only point in my comparison is to suggest that in asking the manufacturers and others of the Province to negotiate three jumps not in succession but all together, if such a thing is possible, we should not be surprised or disappointed if a little practice is required. May I refer now to the three jumps, or new ideas. First of all, the necessity for scientific research. It would be somewhat of a reflection on this Institute if I took up your time this evening attempting to prove to you the value of scientific research in industry, because hardly a week goes by but what you listen to some convincing demonstration of its value. May I speak briefly with regard to the things which I have seen during the past two years in other countries with an attempt to correlate them with the situation within this Province?

I visited recently an important plant in the city of Toronto and owing to the kindness of the managing director, I was allowed to inspect very carefully the organization as a whole. This particular company is shipping its products to practically every civilized country and in this way attempting to meet competition from England, Germany, and the United States. The reason for my visit was that they had secured samples of products made in

Germany far ahead in technical characteristics of anything that they can manufacture at the present time. They confessed to me that they were virtually in a new world examining the samples which lay before us, and expressed the view that if these products were marketed in this country with any degree of knowledge of Canadian conditions things would be very uncomfortable for the Canadian manufacturer. Faced as we are, therefore, with this potential competition not merely abroad but at home, we do well to examine carefully the methods which have been adopted in other countries. Take Great Britain for example. Largely due to the urgent need of various manufactured articles during the war which could not be produced within the country, owing to the absence not only of equipment but technically trained experts, the eyes of the Government as well as of industry were turned upon the organization of the industrial machine as it then existed, and a loud exclamation was made when they found that, compared with their great competitive nations, they had been asleep for many, many years. The most easily recognized outcome of this awakening is to be found in the twenty or more industrial research institutes which exist at the present time in Great Britain. I have personally visited many of them and I know something of the quality of work which is being turned out. Take the woollen industry as an example. Since the war particularly, the woollen industry in Yorkshire has not been flourishing from a financial point of view. The manufacturers are faced with increasing competition in those

countries of the world which before the war depended almost entirely upon England for their supplies of manufactured woollen goods. The influence of substitutes is also reducing demand and I suppose there has never been a time in the history of the woollen industry in any country when there was greater need for efficiency and good judgment. At Leeds there is to be found a research institute devoting patient thought and inquiry to the most fundamental questions underlying wool and its fabrication. The woollen manufacturers in the British Isles have voluntarily agreed to a levy of sixpence per bale of wool with a pro rata subscription from the finishing trades to support this institution. Crossing the Pennine chain into Lancashire, the home of the cotton industry, we find a similar condition except that, speaking generally, the plight of the industry is worse. Since the war one hundred millions of dollars have been paid by common shareholders in the cotton mills of Lancashire to replace loss in working capital. Faced with this situation may I quote to you the words of one of the most able men in the cotton industry. This gentleman is the head of a company which, in spite of the general condition of the trade, has for the last seven years been able to pay a dividend of ten per cent. The company does not owe the bank a penny, and at the present time they are engaged in constructing in the heart of Manchester a most beautiful building somewhat resembling one of our own downtown skyscrapers. What is the explanation of this striking exception? He says: "We are stronger believers than ever in



the application of science and I think if I were asked what particular section of our business had been most valuable to us in helping towards our success I would unhesitatingly say the research department. We started the work rather differently from many other concerns. We made up our minds that we would endeavour to solve a particular problem which had baffled the cotton industry. I remember reading an address given by Professor E. H. Starling in which he says:—"Even a lifetime devoted to science and research seems incapable of preventing us from accepting familiar appearances without trying to understand them. It is not until someone puts a definite question and our curiosity is aroused that we become aware of a problem to be solved. In science it is the question that matters, the solution can always be found.

"We took up our question some ten or twelve years ago. The solution has not yet been completely found but we are on the way and during the course of our work our scientists have found a good many other things that have proved very useful and there is no doubt the whole outlook of our business has been immensely improved through science."

The first jump, ladies and gentlemen, an inquiring mind, an unwillingness to accept familiar appearances, a capacity to put the question, patience and faith to carry on over a period of years, knowing full well that even if the original objective is never reached, the by-products of the investigation will more than compensate for the expenditure of money involved. The Toronto plant which I have pre-

viously mentioned has fine technical skill, efficient machinery and loyal workpeople, but no person or persons capable of tackling the problem, the answer to which might determine the whole future of a great enterprise. The second jump. I said a few moments ago that the Mellon Institute was essentially a private corporation carrying out scientific research for the benefit of individual private companies. Whatever the letter of the legislation creating the Foundation may be, the spirit of the undertaking is that of a public body charged with the duty of assisting industry and agriculture on a broad basis rather than on the basis of a personal contract. We therefore ask groups of manufacturers to co-operate together and this presents a difficulty. The genius of the people of this Province has been shown in no more characteristic way than by individualism and self-reliance in the development of their business affairs. The efficient man in particular does not take kindly to the thought of sharing in the investigation of a problem which will inevitably involve an exchange of confidences, if you like, and perhaps the handing over of information and methods which he considers to be valuable assets in his own particular business. Although it is natural, however, the objection should be judged in the light of actual conditions. There is really very little secret information to-day in manufacturing. The different degrees of success in business are not due to lack of information so much as inability to utilize and apply the knowledge. During the war my colleague, Mr. Ellis, then in charge of the laboratory of the Wool-

wich arsenal, was called upon the visit four different copper manufacturing concerns in Great Britain. At each different plant he was told that owing to his being a civil servant they were willing to break the universal rule that no one should be allowed in the plant other than an employee. At each plant he saw almost exactly the same methods and, what is still more interesting, all the four plants were basing their operations on detailed descriptions to be found in technical literature. But let us allow that this co-operative system of research involves the giving of information and experiences. Isn't it rather an exchange than a gift? And perhaps even the best will now and again, perhaps unconsciously, take back from the meeting of a research group just the idea or suggestion which will unlock a particular problem or difficulty.

The co-operative system is not, however, merely a trial; it is in some respects a necessity in this province. Our industries are not organized in a small number of powerful units with large reserves of capital. We are essentially a province of small manufacturing units with an average payroll of about thirty people. We must recognize as practical men and women that scientific research costs money, and that to ask a small manufacturer to associate with his company anything in the nature of research organization is, in the vast majority of cases, utterly impossible. But they are the very people the Foundation is called upon to help and we are indicating a method by which the very best can be brought within the reach of those who perhaps are

unable to purchase it on any other basis. One final word on this subject. Co-operation in research is most necessary in those branches of industry in which you have a number of highly efficient, progressive companies competing with those which do not merit this description. During the last two years I have over and over again encountered this attitude on the part of various leaders in industry: "We are not only interested in this problem and willing to pay in support of its solution, but if you succeed in solving our problem we don't mind in the least your giving the information to other companies in this field, because we suffer not from competition between well-made products, but the whole industry suffers from the loss of good will on the part of the public, resulting from the sale of manufactured goods which are not up to the standard claimed for them." If you wish to see co-operative research and a general spirit of exchange for mutual good, I know of no country where these are better exemplified than in the United States.

Third, and perhaps the highest jump. Early in this address I mentioned that we are receiving from private persons and corporations and the public treasury an endowment fund of  $3\frac{1}{2}$  millions of dollars. There has been and still is some uncertainty and doubt as to how this money should be spent. One possibility which presented itself was that of encroaching at an unstated rate on this sum of money, and perhaps finishing up at the end of five years with little or nothing in reserve. I confess to you quite frankly that it would be very difficult for

such a system of life and conduct to receive the support of one brought up in the north of England where the principle—if you have an income of so much, you spend a little less—is just as much a part of one's creed as in the more northerly portion of the British Isles. But, apart altogether from the personal views of the Chairman or myself, your own judgment, I think, will support our contention that we should preserve carefully the financial foundation which has been laid and endeavour as far as possible to live within our income. It is useful in this connection to remember that the Mellon Institute, which is now a self-supporting body, was only made possible by an endowment fund of several millions subscribed by the family which gave it its name. Acting on this principle, we are looking forward to receiving at the end of five years an annual income of approximately \$150,000 per year. How does this sum of money compare with the duties and responsibilities laid upon the Foundation? Or how does it compare with the annual appropriations for research not merely of private corporations but of Government departments in other countries? We are charged with the duty of supporting research not merely in industry and agriculture but with regard to the natural resources of the Province, still undeveloped and therefore not at that stage when private interests would perhaps be willing to support and carry on important investigations. Dr. Brandes a few weeks ago addressed your Institute and gave an interesting account of the work of his department at Washington. This department, entirely devoted to problems con-



nected with the raising of sugar cane and sugar beet, is one of seven sections of the Department of Agriculture, Washington, and at the present time in this one field of research an annual sum of \$450,000 is being spent. Take another case. A small group of research directors meets in New York regularly. There are thirty members of the club, all employed by private companies. Their annual budgets for research last year totalled twenty millions of dollars. It is for this reason primarily, the reason of stern necessity, that the Foundation must ask those for whom research is undertaken, those who will benefit by the results obtained, to carry the necessary charges. There will be no difficulty in spending the relatively small annual income of the Foundation in providing those facilities which will be common to all of the research laboratories and in supporting numerous scientific endeavours which in any liberal interpretation of the Foundation come within our sphere. Even, however, if stern necessity did not dictate this policy, would it not be wise for other reasons? I have stated that in our view the Foundation is essentially a human organization composed of scientific men and persons engaged in the more practical affairs of industry and agriculture, many of whom will also be men with scientific training and a scientific point of view. How are we to secure and retain for the Foundation the active interest and support of such people? I know of no more effective way than to ask them to carry the charges of what is done. This will bring to the Foundation not only interest and suggestions but also the invaluable

asset of criticism which is based on sympathy and understanding. I do not wish to belittle the corresponding advantages which will come to the manufacturer from his contact with research men, but I do maintain most earnestly that the research work carried on in our laboratories can only have real value if it is transmitted through human contacts to the affairs of day to day industry and agriculture.

I have spoken of these difficulties but in spite of them I feel that I am justified in stating that real progress along these lines has been made and that during this coming year several more groups of manufacturers will be formed and enter into a working relationship with us along the lines which I have suggested.

Speaking as a member of this Institute I should like to say one or two words about two matters with regard to which we require your earnest coöperation. For many years, particularly in those immediately following the war, this organization and many similar bodies in Canada did important work in giving dignified publicity to the work done by scientific men in this and other countries, and in endeavouring to get a proper recognition of the research man in our national life. I am not speaking only of his position in industry and agriculture but also in the teaching institutions of this country. During the last two or three years with the establishment of the National Research Council and similar provincial bodies in Ontario, Manitoba and Alberta your efforts have been rewarded, and in the universities we have witnessed a rapid development of graduate work which

usually involves research work and the training of men along such lines. We all recognize the progress which has been made, but may I suggest that there is a great danger of institutions such as this resting on their oars and failing to realize that, although much has been done, still more needs to be accomplished. Speaking not only for the Ontario Research Foundation, I state most emphatically that we still require your constant assistance, not necessarily part of some scheme, but rather a sympathetic collaboration between two bodies engaged in practically the same field of activity. We all recognize most sincerely the value of the educational work which you are doing and from which we have derived benefit and will continue to do so.

My last point in this preliminary portion of my address is one which is very much in the thoughts of the Chairman and anything which I may say in this connection I am sure will meet with his approval. The basis of scientific progress in relation to industry and agriculture is made up of principles or natural laws with an uncoördinated wealth of scientific observation made in the laboratories of men and women engaged in the search for scientific truth for its own sake. At a time when we are attempting to organize industrial scientific research we shall do well to remember that it would be purchased dearly if it is at the expense of those institutions in which fundamental scientific work is being carried on. It is not only that we must look to these institutions for knowledge, but it is in the atmosphere of research laboratories of this type that men and women

develop, cultivating that creative faculty about which I have previously spoken. A wealth of technical knowledge is not necessarily a prerequisite to scientific research capacity even in the field of industry or agriculture, and may even constitute a severe handicap. One cannot help wondering at the puzzle that is presented by 19th century science in Great Britain. Let us confess, if you will, that it was unorganized, that it was conducted without much sympathy for agriculture or industry, but the fact nevertheless remains that, starting with Dalton, the page is covered with the names of distinguished men in all branches of science, a page which is so rich as to compare favourably with that of any nation.

May I take this opportunity of expressing the gratitude of the chairman and members of the staff of the Foundation for the very generous assistance which we have received during the past two years from members of the staff of this University and similar institutions within the Province. Our laboratories have been designed and fitted up with the same technical knowledge and almost tender care which Colonel LePan and his staff devote to the buildings of the University. There is hardly a week goes by without some member of my staff visiting the different departments of the University to ask for information and help, and it has been given most generously. This assistance is none the less helpful and acceptable if sometimes it is accompanied by a humorous and, I must say, penetrating analysis of what I suppose are the inevitable foibles and peculiarities of a Research Foundation.

## INDUSTRIAL RESEARCH IN CANADA IN 1930

THE year 1930 probably marks the commencement of another period in the industrial history of Canada. For the past five or six years we have witnessed steady growth and development in practically all branches of manufacture. It has been a period during which the important problem has been the production of a sufficiently large quantity of manufactured articles of the right quality and design to satisfy a steadily increasing market both at home and abroad. Looking back over this period one must pay tribute to those qualities of faith and enterprise coupled with the energy which is characteristic of our people. The situation as we see it to-day is in striking contrast to our own attitude of doubt and misgiving when, during the early years of the war, we undertook the organization and development of branches of industry of a highly technical character which were entirely new in a country which up to that time had been essentially one in which agriculture and the development of raw materials were dominant. It is not until one looks back that it is possible to realize the true magnitude and significance of what has been accomplished during these last few years. Furthermore, we have as a people decided that in industrial matters we shall not think only of our own internal needs and requirements but make determined efforts to engage in world trade. Some



few weeks ago during a visit paid to a well-known industrial plant in the city of Toronto, the writer learned from the general manager the destination of the products which his particular company was producing. The list included practically all the civilized countries of the world, and to a greater or less extent this condition is characteristic of Canadian industry as a whole. Economists and statisticians by an examination of the trade returns of this country have over and over again demonstrated the relatively high position which Canada occupies in the field of world commerce.

Signs are not lacking that we are now at the commencement of one of those recurring periods during which the minds of industrialists will be occupied not so much with problems of production but with the development or the maintenance of markets which they at present hold. Production, on this continent at least, would appear to be either stationary or in some instances on a reduced scale. During this period our concern will not be with the amount which we can turn out of any given commodity but rather increased emphasis on quality and on the cost at which it can be sold to the consumer. Because we trade in the markets of the world no artificial palliative is going to be of any service or save us from our own shortcomings, and we must realize that what we are setting out to do is not merely to equal but to surpass the business and technical efficiency of older and more established industrial nations.

The attitude of industrial people towards scien-

tific work, and towards scientific research in particular, varies, of course, with the individual. In some cases it is regarded as a relatively harmless frill to be attached to an industrial organization during times of prosperity, and which gives to the organization an appearance of being up to date. In reality the laboratories are the Cinderella of the organization and as soon as turnover and profits begin to fall, or even remain stationary, this superfluous frill or luxury is cut off, and industrialists of this type are inclined to congratulate themselves on having practiced sound economy in getting their organization down to the bed rock of efficiency. Experience has shown, however, that such a policy is in a very real sense dangerous and inefficient. In 1922, the writer had two interesting experiences which will illustrate the two sides of this question. A student who had graduated shortly before from the University of Toronto entered the employ of a company whose plant is situated within this Province. The period of prosperity and intensive production which followed the war had been succeeded by a period of depression, financial loss and curtailed production. I knew personally the employer of the former student and from him I learned what effective service this young chemist had rendered to his company during the short time that the laboratory had been part of their regular organization. In spite of this, however, I was asked to assist the young man in securing another position owing to the fact that he was out of employment brought about by a desire to reduce expenses and not because of any limitations on his

part. Shortly afterwards I paid a visit to the works of an important company in the United States. They also were passing through a similar experience. The plant was closed down insofar as production was concerned but there was this striking difference in the reaction of those in control to a precisely similar economic situation. The research laboratories were in full swing and not only that, the technical men formerly responsible for the conduct of routine operations in the plant had not been discharged but were drafted into the research laboratories in order to speed up investigations which were under way, and at the same time maintain unimpaired the essential features of their whole organization. I told the managing director about my friend who was out of a job in Canada and as a result upon my return to Toronto I was able to offer the latter a position with the American company in whose employ he still remains and is doing splendid work. During subsequent years the history of these two companies has been full of interest and without exaggerating the importance of the scientific element I am convinced that it was partly responsible for the rapid return to normal production on the one hand with ever increasing financial success, as compared with an organization which is still facing the same problem with which it was confronted years ago. Not long ago the director of the research laboratories of an American corporation told the staff of the Ontario Research Foundation that during the past year their own research laboratories has been able to achieve very little owing to the fact that so much of their

time and energy were consumed in helping out with the routine conduct of a large technical organization. He went on to say, however, that as soon as the industry encountered anything approaching depression the research laboratory would be allowed to take up its own particular function with renewed energy and probably with an increase in personnel. The lesson which some years of experience has taught and one which I think should be learned by all industrialists at the present time is to avoid above all things reducing in any way the quality or extent of the scientific work which is done within their organization, owing to the fact that from an economic standpoint conditions have become more difficult. By discarding this important if not essential element we shall throw away perhaps the one instrument which will bring us back to a normal condition. We can at least learn something from those nations with whom we are in the keenest competition. Either England, Germany and the United States are far-sighted and understand what they are doing in devoting so much time and money to the scientific side of industry and agriculture, or else they are wasteful almost beyond belief. The position of these countries in the markets of the world is hardly evidence of sheer incompetence, and if not it seems quite clear that we must not only imitate but examine critically the system which they are following, reproducing in Canada the things and the methods which we know have proved to be helpful. May I repeat that in 1930 whatever else is sacrificed in the interests of economy and efficiency it is to be hoped that no

worth-while individual or laboratory engaged in scientific work will lightly be cast aside.

A frequent answer made by administrative authority to arguments such as those which have been used, is that the scientific staff and the laboratory have not shown any saving, but rather have been a heavy expense. No one would maintain that scientific men differ essentially from the rest of their fellows, and they may not all be highly efficient and productive. It is quite true that in certain cases, owing to an unhappy choice of men, scientific work may be unproductive and in the long run distinctly harmful by reason of its inefficiency, but this argument might be applied with equal truth to any branch of industry. One reason which frequently causes administrators to use this argument of expense and no return, with real conviction and sincerity, is that they charge to the laboratory every item of expense connected with it but there is no system by which the returns obtained can be credited to the laboratory. Slight alterations are made to the process, a better material is purchased and by imperceptible stages the whole character of an organization changes, but

is all taken as a matter of course and the credit side of the laboratory is dependent upon some outstanding and spectacular result, the sort of thing which only occurs in any laboratory at long intervals. Where both sides of the ledger are carefully attended to I do not think such doubt will arise. Whilst engaged in preparing this article I was interrupted by the visit of another Canadian who is engaged in the development laboratory of an American com-



pany. He just told me that during last year the laboratory cost the company \$10,000 and was credited in the books of the company with returns valued at \$40,000.

If it is necessary to avoid the curtailment of scientific endeavour during the coming year in Canadian industry it is equally essential that those organizations in which at present no attempt is made to do this kind of work should reconsider, as they have never done before, the full question. The writer is of the opinion that before scientific research as such can be of any value whatever to Canadian industry as a whole it will be necessary first of all to reorganize and control much of the day to day routine operations of industry along scientific lines. Our primary concern is not to undertake new things but to buy and to manufacture in a better way than we have ever done in the past. In the relatively simple field of purchasing departments, economies and savings could be brought about which would lead to astonishing results. In the first place industrialists would learn to trust more and more in the work of technically trained men as a result of the lesson which had been learned, and secondly funds would be available within the organization to undertake work which could perhaps more truthfully be described as scientific research. Only a few weeks ago two Canadian companies amalgamated. As in many cases of this kind one company was under the control of a man of great ability and keen imagination and his first change in the organization of the second company was to introduce into the plant a young

chemist to direct and control the purchasing of raw materials and chemicals. More capital was placed in the larger organization, more and better equipment purchased and the general overhead has gone up as a result, but the striking fact is that the savings brought about in this purchasing department are sufficient not merely to pay the young man's salary but to cover interest charges on new capital and to meet increased overhead and amortization of new equipment. This revelation of sheer loss in efficiency and in money has come to scores of men who for the first time have tried to find out the real quality of the materials which were entering the various plants. To substitute accurate chemical and physical data for the empirical and often biased opinion of men whose sole claim to have authority is that they have been buying such a commodity for a certain number of years is a simple task which can and should be undertaken in many sections of Canadian industry.

Having secured control of raw materials, the next stage in the reorganization is to check up every stage in its subsequent history. During the last two years men in trouble and difficulty have brought to the Foundation articles which they produce and which were faulty in one or more respects. The process of manufacture was probably made up of numerous stages, each one bringing about some definite contribution to the production of the article, and the first question one naturally asked was, "At what stage or during what particular process did your raw material commence to go wrong?" And over and over again one received the quite truthful answer, "I don't

know." The solution of such a problem is made doubly difficult in some cases, or becomes impossible of solution, owing to the fact that there is no method of recording each stage of the process from day to day in terms of simple chemical or physical data. To illustrate how some batch of raw material can get out of control, mention will be made of a sample of knitted underwear which was sent to the Foundation some months ago. It was one of 5,000 similar pieces, all of which were quite unfit for wear, the upper half of each was light and the lower half much darker in colour. The manufacturer was at a loss to know at what stage the trouble had developed. Instances of this kind could be multiplied. They all point to the necessity of having under control every stage of an industrial process. This ideal can only be achieved by placing operations under the control of men who thoroughly understand what is going on, and who by checks can detect in the shortest possible time deviation from what is considered to be the normal. Only in this way can we reduce, and if possible eliminate, the great economic loss due to articles which are described as understandards. Recently it was brought to our attention by a manufacturer that in one line he was producing 25% of such articles. He was determined to do everything possible to reduce this quantity and, furthermore, having arrived at a solution he expressed his willingness to impart the information to his competitors, some of whom were producing only 50% of high quality goods. His willingness to assist them was not merely due to brotherly feelings but in a real sense arose from a

desire to improve his own position. As he pointed out, the mass of low-grade products produced by himself and others was destroying the possibility of selling high-grade articles. This incident brings to the front another important element which should characterize the development of scientific research in Canadian industry. That is to say it should be, to as large an extent as possible, co-operative in spirit. The need for this attitude is partly financial owing to the fact that speaking generally Canadian industry is an aggregation of relatively small units standing alone. Small individual companies could achieve very little in the field of scientific research, whereas by pooling what resources are available, work could be undertaken which will be of inestimable value to those who share not only in the cost but in the results obtained. Furthermore, in co-operating on the technical side of industry the gain is not on the part of the few at the expense of others. The sum total of experience and knowledge brought about by this attitude is so much greater than could possibly be found in any one single organization that in the end even the most up-to-date and the most efficient gain something from the experience.

In order that even the smallest of industrial units in this Province may bring into its work and activities generally the point of view and the experience of well-trained scientific men, the Ontario Research Foundation has, during the last two years, endeavoured to support those associations which already exist for the conduct and support of scientific research, and in those industries where no such organization exists

has endeavoured to stimulate their formation. For the past year the Foundation has worked in close harmony and co-operation with the Canadian Woollen Manufacturers' Association in this type of endeavour. The laboratory has been able to handle a steadily increasing number of enquiries from members of the Association. The work has not only increased in quantity but we have observed even in such a short time an intensified or awakened interest in problems which are not routine in character but which will require for their solution laboratory research extending over a period of time. So far the number of research associations in Canada is quite small in comparison with the twenty-four flourishing Associations or Guilds which are functioning in Great Britain.









